# TEXTILE RESEARCH

*Publication of Textile Research Institute, Inc., and The Textile Foundation*

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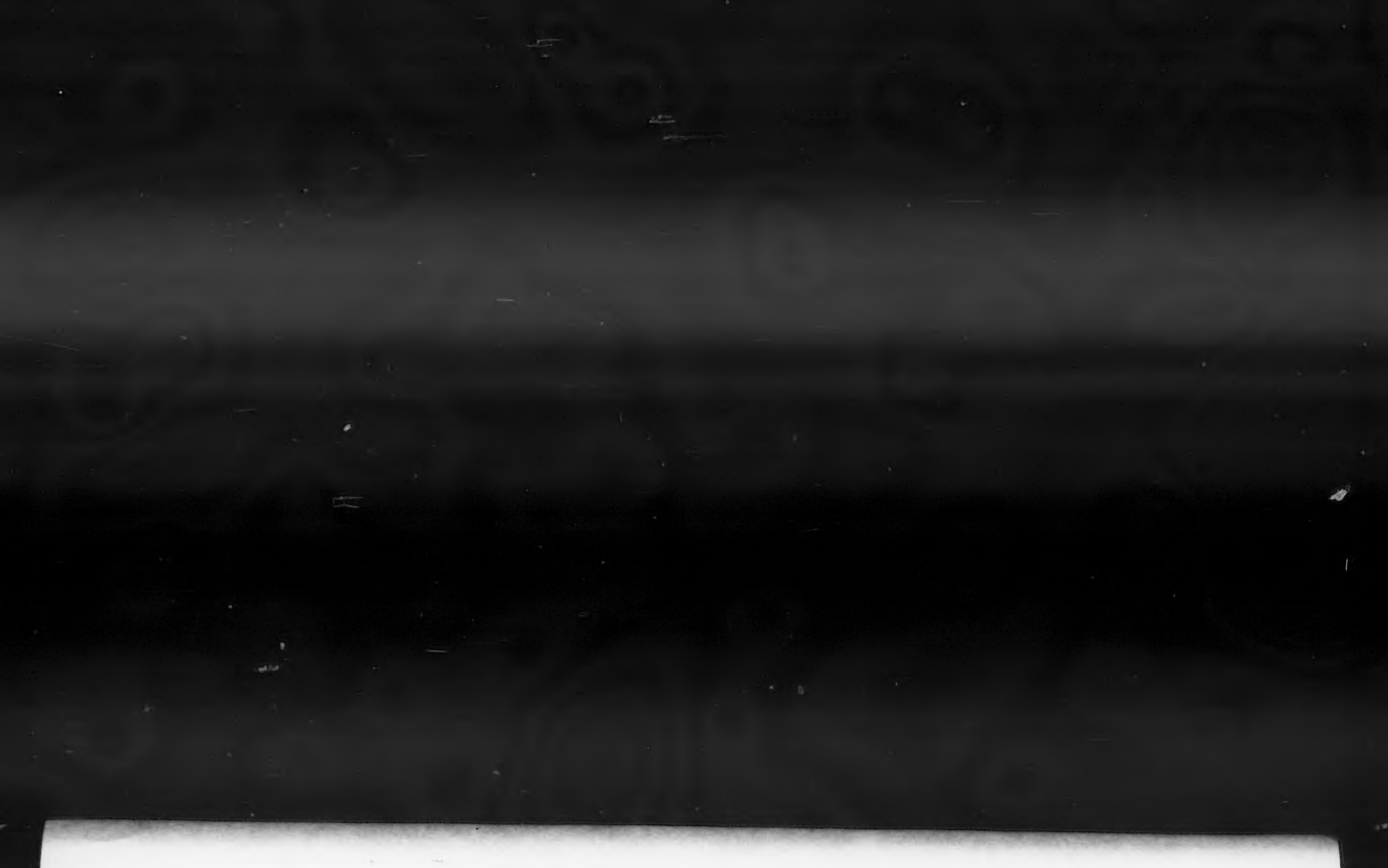
VOLUME XIII · **SEPTEMBER, 1943** · NUMBER 11

# TEXTILE RESEARCH

**VOL. XIII SEPTEMBER, 1943 NO. 11**

Published monthly by Textile Research Institute, Inc., and The Textile Foundation. Publication Office: Prince and Lemon Sts., Lancaster, Pa. Editorial and General Offices: Room 2701, 10 East 40th St., New York 16, N. Y. Editor: Julian Jacobs. Publication Committee: Douglas G. Woolf, chairman; M. Earl Heard; Stanley B. Hunt; Dr. Louis A. Olney; Robert W. Philip; E. R. Schwarz, F.T.I. Subscription (available only to those not eligible for membership in Textile Research Institute, Inc.) $5 a year; foreign $5.50. Contents copyrighted 1943 by Textile Research Institute, Inc.

Entered as second-class matter, October 29, 1932, at the Post Office at Lancaster, Pa., under the Act of August 24, 1912.



VOL. XIII **TEXTILE RESEARCH** NO. 11

Outstanding Features in

# This Month's Issue

### Industry-wide Research Program

A plan for linking the activities of Textile Research Institute, Inc., with one of the outstanding universities, thus forming a tie-up between textile research and higher education has been formulated by the Institute. (See page 2.)

### New Economic Research Committee

Robert R. West, president of the Esmond Mills, has been appointed to the chairmanship of a new economic research committee of Textile Research Institute, Inc. (See page 4.)

### Research and the Patent System

Benefits to the corporation from employment of patents, and the main points to be considered in their commercialization are discussed. (See page 10.)

### The Lateral Expansion of Cotton Fibers Under Tension

Measurements have shown that, in general, cotton fibers undergo a lateral expansion under longitudinal tension. This characteristic may influence the behavior of yarns and cords under certain conditions. (See page 21.)

### Proper Starching Technique

A study of the effect of certain variables on fabric stiffness discloses an important relationship. (See page 26.)

**Linking Research with Higher Education Features Textile Research Institute's**

# Industry-Wide Research Program

SUBMISSION OF A PROGRESS REPORT on plans for linking the activities of the Textile Research Institute, Inc., with one of the outstanding universities, and unanimous approval of the broad framework for the future of the organization, as set forth in a detailed memorandum recently mailed to its nearly 400 members, featured a meeting of the Institute's board of directors held in New York, August 26.

The action followed a meeting the previous day of the Institute's technical research committee, at which specific research plans were formulated. Several of the projects considered are important to the war effort.

"Textile firms in the 1940's, like the American patriots of the 1770's, must hang together—or they are all too likely to hang separately" is the theme of the memorandum which was endorsed by the directors.

This pamphlet, which is available to all textile men on request, is a preliminary step in connection with the announced program of raising a $2,000,000 fund at the rate of $300,000 a year for a five-year period, plus a capital sum of $500,000.

The present position of the industry must be safeguarded, the pamphlet states, increasing competition must be offset and postwar expansion assured. To secure these the Institute has set out to accomplish five goals: fundamental research in all the major fibers, both natural and synthetic; applied research in each of the major branches of the textile industry; economic research; information service of timely and topical importance; and graduate training in cooperation with a university.

No longer can the textile industry remain near the bottom of the list in research expenditure. A recent report of the National Research Council comparing 16 major industries showed that textiles and their products were spending only 6 cents per $100 of value added as against an average for the group of 64 cents.

Such an institute as is being developed will represent the mutual interests of all phases of the industry, rather than that of any one branch or section. Thus, lines of demarcation among types of mills and fibers can be eliminated.

Other major advantages of cooperative industry-wide research described in the pamphlet are:

1. Long-range, fundamental research, which seldom yields a quick profit, can rarely be undertaken by an individual company. It is, however, a proper function of the central research agency.

2. A well-organized, highly-sponsored central agency, especially one affiliated with an outstanding university, will attract the best available scientific brains—to the benefit of the industry as a whole.

3. Such an agency will feed into the industry each year a number of men highly trained in textile chemistry, physics and engineering. These men will do much to meet the industry's need for the most competent technical and managerial brains.

4. Most important of all, the textile industry, through one central research agency, will present a united front to the growing competition from other industries. The competition which the textile industry is certain to face after the war from the paper, chemical, and plastic fields is already increasingly evident.

Well equipped to render research service to the entire industry, the Textile Research Institute, Inc., has since 1941 in cooperative arrangement with the Textile Foundation broadened its influence so that now it is the only cooperative body covering all the major fibers. Its membership list now includes many of the leading units in all branches of the textile industry, as well as many of the outstanding research men in the country.

**Robert R. West Becomes Chairman of Textile Research Institute's**

# New Economic Research Committee

"THE AMOUNT OF ECONOMIC RESEARCH to be done in industry is well appreciated. It is hoped that this committee will be useful in bringing this subject into focus and successful in arranging for significant studies to be made."

The above statement was made by Robert R. West, president of The Esmond Mills, Inc., in accepting the appointment to the position of chairman of the economic research committee of Textile Research Institute, Inc.

Stanley B. Hunt, president of Textile Economics Bureau, Inc., and former chairman of the committee, felt obliged to resign that position because of extra duties in connection with the war effort which necessitate his spending a considerable part of his time in Washington. Mr. Hunt will continue to serve, however, as a member of the committee.

In addition to Mr. West the members of the committee are: F. W. Binzen, merchandise manager, J. C. Penney Co., Inc.; Miss Irene L. Blunt, executive secretary, National Federation of Textiles; Flint Garrison, publisher of *Garrison's Magazine,* and former president of the Wholesale Dry Goods Institute; A. Ford Hinrichs, Acting Commissioner of Labor Statistics, U. S. Department of Labor; L. A. Hird, treasurer, Samuel Hird & Sons; Luther H. Hodges, vice-president, Marshall Field and Co.; Stanley B. Hunt, editor, *Rayon Organon,* and president, Textile Economics Bureau, Inc.; Lt.-Colonel Stephen J. Kennedy, in charge of the Textile Branch, Research and Development Div., Quartermaster Corps, U.S.A.; H. E. Michl, economist, Cotton-Textile Institute; and Douglas G. Woolf, editor, *Textile World.*

The Institute is most fortunate in securing Mr. West as head of this committee. Not only is he one of our leading mill executives; he has long been an exponent of eco-

**Robert R. West, chairman, economic research committee, Textile Research Institute, Inc.**

nomic research within the industry. He and his committee are in a position to guide the Institute toward the most effective use of a form of research certain to become increasingly vital to the welfare of the textile industry.

A graduate of Harvard in the Class of 1915, Mr. West started as an apprentice in the textile industry the next year. He has been associated with the Lawton Mills, the Roxbury Carpet Co., the Lancaster Mills, and, from 1930 to 1940, with the Riverside and Dan River Cotton Mills. In 1940 he was appointed director of the Bureau of Industrial Research at the University of Virginia. In December 1942 he became president of The Esmond Mills, Inc.

The chief function of the Institute's economic research committee is to recommend to the Institute important projects in economic research and to supervise their production.

Under leadership of Mr. West and with an active personnel representing broad textile interests, the new committee will extend the scope of the Institute's activities in the field of economic research and enhance the value of the services being rendered to the industry.

An early meeting of the committee is planned for the purpose of considering various projects that may properly be undertaken by the Institute.

# RESEARCH ACTIVITIES

Malcolm E. Campbell has resigned his position as research manager, Textile Research Institute, Inc., in order to accept the position of dean of the Textile School at North Carolina State College, Raleigh, N. C. Mr. Campbell will continue to be associated with Textile Research Institute as a member of the Institute's technical research committee.

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*Winifred N. Pardey has resigned her position with A. M. Tenney Associates to become associated with General Dyestuff Corporation in its testing laboratories. Prior to her connection with the Tenney Associates, Miss Pardey was laboratory technician with the Warwick Mills.*

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All of the basic research activities of the American Viscose Corporation will be conducted at the corporation's plant in Marcus Hook, Pa. Dr. Charles S. Venable, previously in charge of the chemical research laboratory at Marcus Hook becomes director of chemical research for the corporation, and William Koster, previously in charge of acetate rayon and "Vinyon" research at the company's plant at Meadsville, Pa., has been named assistant director of chemical research.

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*Reuben B. Rapp, formerly vice-president of Riverside Yarn Mills at Riverside, New Jersey, has joined the Textile Research Department of American Viscose Corp.*

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At a recent meeting held in New York, the organizers of the new Institute of Textile Technology elected Ward Delaney executive director. Mr. Delaney was formerly on the staff of the Institute of Paper Chemistry, Appleton, Wisconsin. Fuller E. Callaway, Jr.,

vice-president of Textile Research Institute, Inc., is one of the organizers of the new institute. The Instifute of Textile Technology will engage in fundamental and applied research confined to the cotton industry, while the Textile Research Institute, Inc., represents all branches of the textile industry.

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*The annual intersectional contest of the American Association of Textile Chemists and Colorists will be held in New York, Friday evening, October 22nd in conjunction with the regular meeting of the New York section.*

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At the annual series of special research conferences held at Gibson Island under the auspices of the American Association for the Advancement of Science, this year's textile section was a five day conference under the chairmanship of Dr. Milton Harris. Among the subjects on which papers were presented were: Textile Physics, by K. L. Hertel; X-Ray Structures of Protein and Protein Fibers, by I. Fankuchen; Cell Wall Structure as Related to the Strength of Cotton, by E. Berkley; Chemical and Mechanical Properties of Vinylidene Chloride Polymers, by R. D. Lowry and R. Wiley; Application of Starches, Glues and Water Soluble Synthetics to Textile Fibers, by A. M. Sookne; The Swelling of Fibers, by E. I. Valko; Fundamental Properties of Glass Fibers and Their Fields of Industrial Application, by James Slater; and The Electron Microscope and Fiber Structure, by R. B. Barnes.

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*Bernice Bronner has been appointed vice-chairman of the membership committee of the New York Section, American Association of Textile Chemists and Colorists. Miss Bronner is in charge of the textile laboratory of Good Housekeeping Institute and is secretary of the American Association of Textile Technologists.*

**New British Rayon Federation Recognizes the Need for Accelerated Research and Cooperation Within**

# The British Textile Industry

"I NOTE THE FACT THAT, with the exception of the rayon producers as such, practically all the members of the Federation are interested in other fibers as well as in rayon, and also that these other members constitute the voting majority. This, I think, is the best possible guarantee that the Federation will maintain a friendly and cooperative attitude toward the older textiles—wool, cotton, silk, linen, etc. Under such a federation our own industry will be guided by men with multiple responsibilities and varied experience and it will not take an aggressive sectional view and try to push rayon unfairly at the expense of other fibers."

The above is quoted from an address by Samuel Courtauld, president of the newly formed British Rayon Federation. This address was delivered before the recent general meeting of the Federation in London. These remarks coming from a leader in the British textile industry are indicative of the trend of thought in Great Britain. Some excerpts from Mr. Courtauld's address follow:

I think it is a happy circumstance that the manifold complexion of our body puts us in a position—in fact, almost compels us—to take a broad national view and consider many other interests besides our own. We all feel that disinterested views, in business and out of it, are needed today as perhaps never before, and we are lucky in having formed ourselves into an organization of such a kind as will almost automatically prevent us from forgetting this.

Now this interlocking of interests between rayon and other textiles is not only commercial and organizational; at the same time it happens to go deeper than that, for

it is technical, too. We are all growing to feel more and more that the future expansion of rayon will find its biggest scope in mixtures with other textile materials. I think that the field of mixtures is hardly more than scratched yet, and that, as time goes on, the mills and sheds of this country will be found using some kind of rayon in ever bigger numbers.

**Research and Advanced Education**

I must say a word here about research. I hope this Federation will take a live interest in that great question, and that before very long we may together prepare a scheme to set up an ample and first-class research institute to assist each branch of our industry in the line of progress which especially interests it.

Although admirable work is being done by existing research institutes primarily interested in cotton, wool, linen, etc.,—and any new organization we set up must be closely linked with these, in view of the interlocking of our technical problems with theirs—the rayon field is already so large, and will be so much larger yet, that there is plenty of room for a research institute of our own.

I am one of those who believe that England rested far too long upon her oars, and that other countries have gone ahead of us in many technical fields—this is certainly true of textiles. Many recently published statistics, which are beyond contradiction, prove that all the big manufacturing nations of the world spend far more proportionately upon research than we do, and I am firmly convinced of the necessity of redressing the balance without delay.

Closely connected with research is the question of training our technicians. A rayon research institute might well form a center for training advanced students selected from the various textile schools of the country—or it might be closely linked to such a new center. What all industry needs today, and, I think, our industry in particular—especially if we are to meet overseas competition in export markets—is a type of technician who combines the old practical virtues with the new scientific method and outlook.

**Methods for the Employment of Patents Are Outlined in**

# Research and the Patent System

## Part III.—The Commercialization of Patents

**By H. WICKLIFFE ROSE***

*Benefits to the corporation from employment of patents, and the main points to be considered in their commercialization are discussed by H. Wickliffe Rose. A series of articles by Mr. Rose commenced in the June issue of* TEXTILE RESEARCH *with a discussion of inter-research. The final article will appear in the October issue and will consider certain aspects of relationship of research with the corporation. This entire series will be made available in reprints bound into pamphlet form.*

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THE BENEFITS ACCRUING FROM EMPLOYMENT OF PATENTS far outweigh the bother and abuses caused by those who exploit them. The very fact that there are patent racketeers increases the use of the patent system by some corporations. Although the defensive tactic of patenting all possible ways of doing something in order to protect the corporation from a possible holdup undoubtedly burdens the Patent Office with inoperative patents, it still has the good effect, and one which is of much more importance, of stimulating research and development. It was with that primary purpose that the original patent law was enacted. A corporation which has been passive to patents, using those which it might have acquired in the natural course of its business, without much thought about them one way or the other, should have the experience of employing a patent estate commercially in a comparatively new field to see the stimulating and concentrating effect it has on the men doing the development work.

* H. Wickliffe Rose, coordinator of research planning, American Viscose Corporation, Wilmington, Dela.

Part of the benefit from applying for patents comes from reduction to writing and reduction to practice. The test of patentability will often filter out nebulous ideas and faulty designs. If an idea has not enough essence to pass through the point of a pen it probably is not ready to aid the corporation; and if a device or formula does not work, it obviously must be corrected before it can be used. It usually follows then, that the patent-minded corporation is orderly minded in its organization and conduct of work.

Nor should a corporation overlook the individual personal effect of patents. A patent can be a reward for a particular piece of research which constitutes the scientists only return, and in the patent he takes the same pride that an author does in a book. Just as there are books of poems published by authors at their own expense, so there are patents issued which are doomed, before they are issued, never to be employed. To that extent again, the Patent Office is burdened, but there is justification for much of it. There are only so many opportunities for a man to derive recognition and pleasure from his work, and, if it is not carried to extremes, this one should not be denied. Patents are also a reward for the group and department as well as for the individual. In many companies the number of patents acquired is a measure of the year's accomplishments in research in the same manner as the financial returns in royalties are credited to the cost of research.

**Commercialization of Patents**

Patent-minded corporations which are competitors sometimes find patent pools to be of mutual benefit and in the public interest. In the war of ideologies some words have had their edges sharpened and have been used as weapons instead of purveyors of thought. The term patent pool has been sharpened into a weapon, together with the word monopoly, and both have been so used that sometimes we almost forget that both can be beneficial in the public interest.

There is the case of a patent pool, currently active, which is speeding up a development for the war program, and which is in the public interest now and in peace time.

(*Continued on page 12.*)

Before the pool was formed, and one member was made the administrative head, each party was secretive about his own developments. There was considerable difference in techniques, some diametrically opposed, and the public was being deprived of an important product based on the best practice possible. Although the pool today does not include all competitors active in the field, and should any of the patents be contested or invalidated, which would be unfortunate, nevertheless the pool has already opened up the development and effected an exchange of information which will benefit the war program and the public. The results cannot but be beneficial to the units in the industry, even to those who have contributed nothing, taken no part, or even opposed it, for the markets and technique are becoming established.

The corporation that employs patents freely is familiar with the art in patent literature. This might be assumed to be universal practice, but it is no mean task to get up to date in some subjects, and it is even a greater task to remain so. The organization of research in a large corporation ordinarily provides a patent attorney on the staff of each director of research. At least there should be a central patent department easily accessible to all research laboratories, in addition to outside counsel. The patent attorney can be of great assistance both in bringing the subject of an art up to date for the researcher and in abstracting and interpreting current patents in a given subject. Such attorneys are probably currently engaged in the most concentrated study they have ever made because of the Alien Property Custodian list. In addition to the academic work in patent literature, staff attorneys are frequently of great value as inventors. While diplomacy usually dictates that the invention come through a researcher, the specialized training and knowledge of the patent attorney place him in position to see the solution to a number of research and development problems.

The main point, which can form a guide in the employment of patents, is the question of whether they are in public interest. Herbert Morrison, British Home Secretary said in a recent speech, "Social control of pro-

*From photo by Ewing Galloway, N. Y.*

**Fig. 1. Dept. of Commerce Building, Washington, D. C. The Commissioner's Office, the Application and Trade-Mark Divisions, the Public Search Room, and Board of Appeals are located here.**

duction may take different forms. The sole test must be whether or not public interest is served." If the patents, or pool, or estate passes that test then it follows almost as a correlary that it is in the interest of the corporation. With the future course of the law uncertain, both as to patents and corporations, a course of action which meets this test would hardly come into serious conflict with either. If it should, however, then quite possibly the conflict will be worth while in its effect in steering the course of law to coincide with the ultimate public interest. Granted that judging the public interest is a large order in itself, yet each individual and each body of management has the responsibility of being its own bar and bench.

Having determined the broad interest, and assuming a commercial interest in the patent, there should be evaluated, in the order of importance a license or licensing program, royalty, price, and terms of agreement.

The first three, license, royalty, and price should be considered first in regard to validity. In a patent system in which validity is not certain until litigated, in which decisions are frequently adverse to patents, and in which

litigation is costly in time and money, the question must be carefully weighed whether to employ the patent alone or commercialize it and invite possible opposition.

Balancing this equation is the fact that access to the invention at low cost prevents opposition in many cases. The amount of the royalty, therefore, should be considered both to close the deal and to avoid a contest if there is doubt of validity. Furthermore, whether to charge a royalty at all must be considered in its effect, per se, in validating the patent. The method of billing and collecting the royalty must also be considered, particularly if the patent is to be employed in connection with the sale and use of material not subject to patent.

The cash payment, if any, again must be considered both as to its effect in closing the deal and in respect to validating the patent.

**The Agreement**

The simple agreement is preferable to the lengthy and involved one. In a complex subject, a simple agreement is not always practical, but patents and their commercialization can be made more attractive to the average business man if they are accomplished briefly. There is no time to indulge in the luxury of unnecessarily lengthy documents. Forms required by Washington today only prove in exaggeration the burden that can be placed on business by paper work.

An agreement is an expression of intention. One of the main purposes of a written agreement is for the guidance of others as well as those who may have made it personally. If the main intent is covered in language clear to anyone, the purpose of the agreement is accomplished. As an attempt is made to cover every possible contingency, then the question becomes less of what is included and more of what is omitted. The best agreement is the one sufficiently flexible to work under unforeseen contingencies. One of man's failings lies in his urge to impinge an inflexible will on the future. The ideal agreement, therefore, is not a monument to the architectural ability of the attorney who drew it, but a product of his collaboration with those who must live with it.

The type of license is of interest. The restrictive license has been the subject of discussion for reform. The answer again might be found in the ultimate public interest. The reaction to elimination of the restrictive license might be less liberality rather than more; for there are many cases in which a license could be refused quite justly, if it could not be restricted. Should compulsory licensing be coupled with abolition of the restrictive license, the patent system probably would be more damaged than improved. The result would be a tendency to the socialization of industry, which course would carry it more directly into government control.

Most licenses, however, are simple and unrestricted. Some are so simple that they are verbal, but the written license is preferable. There should be some record both for the guidance of business conduct and for reference in connection with changes. The state of an art and a business evolve so rapidly in this fast moving industrial world that agreements are frequently amended or entirely rewritten to keep them accurate and in step with actuality.

In developing a patent estate, licenses are sometimes necessary to cover experimental work done by others. Such a license can be issued with or without prejudice to the others position in respect to validity. Such an arrangement can speed up a development through collaboration without the loss of control and the loss of investment and interest. Patents lend an incentive to long and laborious development through control. Politically again, control sounds like monopoly, while industrially it is a necessity in every phase of a well organized operation. The experimental license maintains control by providing for assignment.

Technical service can form part of an agreement which is in everybody's interest. Employment of patents, as compared to exploitation, is best accomplished by a full and continuous exchange of information if an estate in a growing art is involved. A working agreement is, in such cases, better than a static agreement or bill of sale. Collaboration is advantageous to both parties and to the development. Mutual confidence is, therefore, in

the public interest, and should be the basis of research, development, and the commercialization of patents.

In the employment of patents, trademarks play an important part. In fact, they can be a vital element in a business. Separate and special study is undoubtedly given to the subject of trademarks. In the industrial corporation, the subject is handled by the patent department and by patent counsel. It is appropriate that this should be, for the trademark is the manifestation of the ultimate in the power of a word, in a profession which is founded on precision of language, and in a branch of that profession which is dependent on definition. Trademarks are prolific seeds in the semantics of business, and wherever possible they should be farmed out with patents.

Patents are well known to have a value for trading or cross licensing. Where two companies have patents of mutual interest, exchanging licenses is a natural and simple commercial transaction. Sometimes cross licensing is accomplished with greater ease than a sale for net cash, even though a patent represents a definite investment. If the price is fair, there should not be that difference of view, but such differences exist, and it seems to be more a part of human nature than bookkeeping.

**Future Problems and Prospects**

The foreign rights in patents and their commercialization constitute a problem which is speculative, and dependent on many questions to be answered by the war or thereafter. The countries in which we can operate commercially with patents at the present time obviously are greatly reduced in number.

One prospect which seems to be fairly certain, if we can reason by analogy, is that after the war there will be a tremendous surge of research, development and production. In it all, there will be required more patents than ever before and more work in the patent profession to handle them. Statistics of the Patent Office show that during each war there has been a leveling off of the number of patent applications filed, but following the war in each case there has been a sharp rise in the number. Following the Civil War, the number had tripled by the second year. After the Spanish American War the number increased almost steadily from approximately 42,000 in

1900 to approximately 70,000 in 1914. After the World War the number of applications jumped to over 90,000 in 1921. The patent curve follows very closely that of economic prosperity.

Reading such charts, one can hardly fail to note the depressions that follow these booms after each major war. Reasoning further by analogy, and assuming that there will be a business boom after the present war, the natural reaction is to try to guard against the depression which seems to be nearly as inevitable. The planning of research, patents, building, and expansion should extend at least that far in the future.

As to the future of patents and the system, we can rest assured they will be in demand as long as man is acquisitive. He will be deprived of possessions and his pride of possession only in a state and social economy quite different from what we have known as democracy.

**Fig. 2. Applications filed and patents issued, 1921–1938.**

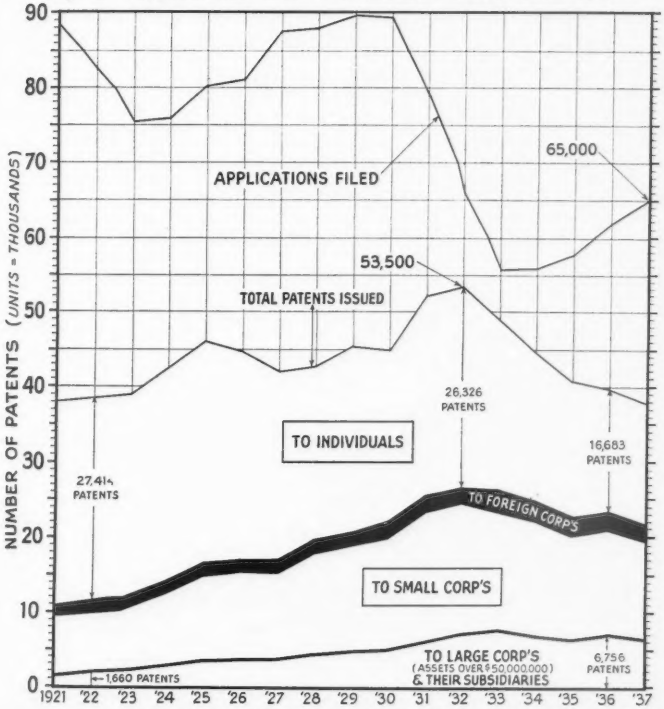


*Chart from "Patents and Industrial Progress." Geo. E. Folk, Harper & Bros., New York.*

**Textile Research Institute Report Discusses the Use of**

# High-Density Cotton in American Mills

**By MALCOLM E. CAMPBELL***

*Interest in the use of high-density cotton has recently been stimulated by two factors: first, the necessity for diverting to domestic use the large quantity of cotton which had been originally packed in high-density bales for export; and second, the possibility that it would be necessary to compress to high density a large proportion of the crop for shipment within the country in order to conserve shipping space.*

*Textile Research Institute, Inc., has investigated the various aspects of the subject, including the feasibility of using high-density cotton in American mills, the effect of high-density compression on spinning quality, and other factors.*

*The results of this investigation are embodied in a fifteen page report of which the following is a summary. This report has been issued to all members of the Institute. Non-members may obtain copies at the price of one dollar per copy by writing to the Institute.*

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In normal times, American upland cotton is compressed to high density for export only, to conserve shipping space. Considerable quantities of high-density cotton were stored in warehouses, practically all of which was of Texas, Oklahoma, or irrigated growth. Nearly 80 per cent of the bales consumed are being taken by mills in the Southeast.

Very few mills in this country had had previous experience in processing high-density cotton, and many spinners experienced difficulty in handling such cotton.

* Formerly research manager, Textile Research Institute, Inc.

*(Courtesy U. S. Department of Agriculture, Cotton and Fiber Branch)*

**Fig. 1. Three types of American cotton bales: (left to right) flat or low-density; standard-density; and high-density bale.**

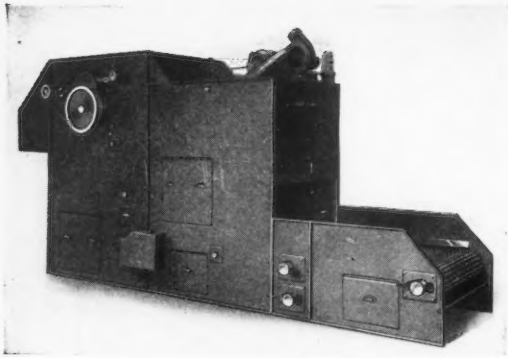
This report summarizes the findings and suggestions of a group of manufacturers who were approached on the subject, and the efficacy of various types of opener-room equipment in handling high-density bales is discussed.

Modern blending feeders, coupled with vertical or Buckley type openers were found to be effective in handling high-density cotton, and mills so equipped experience little or no difficulty with such bales, although blending with cotton of lower density is not recommended.

For mills with obsolete opening equipment, the only solution lies in conditioning either the opened bales or the opened lint. Lack of floor space and man-power precludes such a practice in many cases. According to the machinery builders, little can be gained by way of modifying old-style equipment, although lower feeder production and closer kicker and doffer roll settings may help.

In the light of these findings, it is clear that many American mills are unable to use cotton compressed to high density.

The results of three series of tests are summarized, in which the quality of cotton compressed to different densities is compared. These tests are in practically complete agreement that the compression of cotton to 33



(*Courtesy Saco-Lowell Shops*)

**Fig. 2. Cleaning and blending feeder.**

pounds or more per cubic foot, the equivalent of high density compression, is not harmful to the quality of the fibers when cotton of reasonably good grade is used. The blending of cotton of different densities, however, is detrimental to the uniformity of cotton yarn.

It is suggested that the question of fiber damage at higher pressures be investigated by physical and microscopic studies of fibers compressed with a Carver-type laboratory press.

An investigation of bale cutting in compressed bales is reviewed, in which the true causes of this fault are explained. It was shown that the cuts were caused by the shearing action of unequal pressures in adjacent parts of the bale. The most common cause of these unequal densities is the "dog ridges" which result from the action of the dogs at the sides of the press boxes of most gins. The study also showed that severe cutting results in only negligible damage, and that modifications in bale pressing equipment can eliminate damage.

(*Courtesy Whitin Machine Works*)

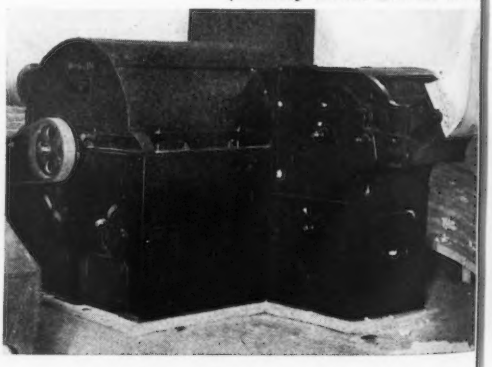


**Fig. 3. Spirawhirl Buckley cleaner and cage section, for use in conjunction with blending feeder.**

**A Characteristic Which May Influence Behavior of Yarns and Cords Is Revealed by a Study of**

# The Lateral Expansion of Cotton Fibers Under Tension

By W. JAMES LYONS*

MEASUREMENTS made in the Southern Regional Research Laboratory on approximately twelve hundred cotton fibers showed, in general, a lateral expansion under longitudinal tension. The effect is of interest since it may be reasonably presumed that this characteristic has an influence on the behavior of yarns and cords under certain conditions.

For the present study, cotton of the Peruvian type (*Gossypium peruvianum*) was selected because the relatively large and full cross sections which can be prepared from its fibers facilitate measurements. The unmixed tuft from which samples were taken was from the crop of 1924–25, graded as Good Middling, full rough, 1 3/16 inch staple. In each of the first two tests (Nos. F–29 and F–31, Table I) the sample of raw cotton was combed and sorted in the Suter-Webb device. From fibers drawn from the 1¼-inch length-array group, flat bundles weighing from 2 to 4 mg. were prepared. In the third test (No. S–18) the cotton used was initially extracted in a Soxhlet extractor for six hours with 95 percent ethanol. After being rinsed in water three times, the cotton was soaked in 1 percent sodium hydroxide solution for four hours at room temperature, and again rinsed in water. It was finally washed in very dilute sulfuric acid, rinsed with water until neutral to litmus, and then allowed to come to equilibrium with atmospheric conditions. A sample of this extracted cotton was hand-stapled to select fibers

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**TABLE I. Comparison of Lateral Expansion of Stretched and Unstretched Cotton Fibers**

**A**

| Test Number | Stretched Fibers | | | | Unstretched Fibers | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean Areas (square microns) | | | No. of fibers measured | Mean Areas (square microns) | | | No. of fibers measured |
| | Whole Section | Lumen | Cell Wall | | Whole Section | Lumen | Cell Wall | |
| F-29 | 175.8±2.9 | 14.9±1.1 | 160.9±3.1 | 215 | 154.6±2.8 | 9.7±0.5 | 145.0±2.6 | 198 |
| F-31 | 191.0±2.5 | 27.8±2.1 | 163.2±3.4 | 172 | 180.8±2.8 | 8.6±0.5 | 172.2±3.1 | 200 |
| S-18 | 184.7±3.1 | 18.7±1.5 | 166.0±3.5 | 200 | 163.4±3.5 | 8.8±0.6 | 154.6±3.3 | 200 |

**B**

| Test Number | Differences: Stretched-Unstretched Fiber Areas | | | t-values and Significance | | |
|---|---|---|---|---|---|---|
| | Whole Section | Lumen | Cell Wall | Whole Section | Lumen | Cell Wall |
| F-29 | 21.2±4.0 | 5.2±1.2 | 15.9±4.0 | 5.30† | 4.33† | 3.98† |
| F-31 | 10.2±3.8 | 19.2±2.2 | −9.0±4.6 | 2.68† | 8.73† | 1.96 |
| S-18 | 21.3±4.7 | 9.9±1.6 | 11.4±4.8 | 4.53† | 6.19† | 2.38* |

* Indicates results are to be considered significant with odds of at least 19 to 1.
† Indicates results are to be considered significant with odds of at least 99 to 1.

of approximately 1¼-inch staple length for this test. From the selected fibers, bundles were prepared as described for tests Nos. F–29 and F–31.

The flat bundles [1] of parallel, single fibers were held at the ends with cellulose tape, over which in turn the jaws of clamps were fitted. These fiber bundles were held under tension in distilled water at loads just below the breaking point for periods of from one-half to one hour. The device for stretching the bundles was of such design that the load could be gradually increased while the bundle was under close inspection. The load in each case was increased until several fibers in the bundle had broken, this effect being taken as an indication that most fibers were under a high tension. That the tensions employed were the highest practicable is indicated by the fact that many bundles were discarded because they broke before the soaking period was over. Cathetometric measurements indicate that elongations of the bundles of about 6 percent occur under these conditions. Similar bundles for control were merely soaked in water for equal periods. The bundles were then allowed to dry to equilibrium with the atmospheric conditions of the room (approximately 50 percent relative humidity at 76° F.), the stretched bundles being held under tension so as to maintain the original stretch. In test No. S–18 both the stretched and unstretched samples were then dried in a vacuum oven at 80° C. for several hours, after which they were again allowed to return to laboratory humidity conditions. As is evident, no special effort was made to secure uniformity between samples.

Following this preparation the wet-stretched fiber bundles, as well as the unstretched controls, were cross-sectioned in a Hardy sectioning device. Photomicrographs of the cross sections were made and enlarged four times to a total of 1000 diameters. On each print so obtained approximately 200 clearly-defined fiber cross sections were selected and numbered. The cross-sectional areas within the fiber perimeter (whole section) and in the lumen were then measured with a polar planimeter. Care was taken in the measurement of each enlarged

[1] Approximately 2 mg. in Test F–29, 4 mg. in Tests F–31 and S–18.

area to assure that duplicate readings did not differ by more than 0.1 cm.$^2$; when larger differences were found, both readings were repeated. The means of the measurements, with standard errors, are summarized in Table I-A. The cell-wall cross-sectional areas recorded are means of the differences between the whole-section and lumen areas of each fiber. In Table I-B the data are further summarized and their significance evaluated.

These data consistently show that the wet-stretching of Peruvian cotton fibers when carried out as described brings about a statistically-significant increase in the areas of the lumen and whole-fiber cross sections. While the apparent changes in cell-wall areas due to stretching are statistically significant in two of the tests, the changes are not consistent as to sign throughout the three tests. This study, therefore, discloses nothing conclusive regarding changes in net cross-sectional areas of the cell walls due to stretching. No influence of the extraction or vacuum-drying on the results of Test No. S–18 is recognizable.

The effect discussed here seems paradoxical if the cotton fiber is regarded as a hollow, deformable, circular cylinder; it would be expected that the lumen would contract, rather than expand, when the fiber is stretched. It must be recalled, however, that the cotton fiber is in fact a convoluted structure, with a cross section which is more frequently elliptical. In longitudinal section a typical cotton fiber appears as in Figure 1. When a fiber is placed under tension the stresses are transmitted through the cell walls. In a wide portion of the section, the tension T, acting across a segment AB, will have a resultant $R_1$ tending to pull the segment AB in toward the fiber axis. In a narrow portion, on the other hand, the tension acting across CD will have a resultant $R_2$ tending to widen the section. Now the cross section of the lumen, as a good approximation, may be regarded as being elliptical. On stretching the fiber, then, the major axis $a$ will be reduced by an amount $\Delta l$, while the minor axis $b$ will be increased by an amount which we may assume to be the same, $\Delta l$. The change in area will then be $(a - b - \Delta l)\Delta l\pi$; $a > b$. This change will be positive

(an increase in cross-sectional area) if $\Delta l < a - b$. This latter condition is maintained since in the course of the stretching, $R_1$ and $R_2$ vanish before $\Delta l$ becomes equal to $a - b$. In the ideal case, in which the lumen cross section becomes perfectly circular, $\Delta l = (a - b)/2$ when $R_1 = R_2 = 0$.

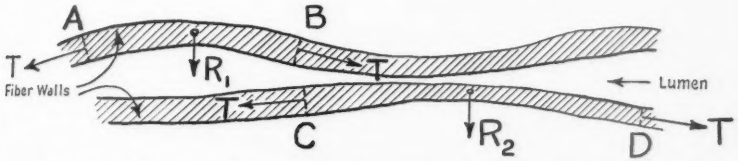


**Fig. 1. Diagram of longitudinal section of cotton fiber in initial stage of stretching.**

In this analysis we assume that the principal effect of the tension is the partial removal of the series of collapsed regions ("convolutions") from the fiber. The removal of these collapsed regions in the manner described here does not require the rotation of one end of the fiber with respect to the other. It is assumed that the extension due to longitudinal strains within the cell wall and the concomitant lateral contraction of the fiber are negligible, and that the reduction in area implied by the contraction is insufficient to offset the increase due to removal of the convolutions. The stretching of fibers in bundles, as was done in these tests, could very likely remove the convolutions before any appreciable longitudinal strains were produced in the cell-wall material. Presumably the water employed has a plasticizing effect, so that after the fibers have dried, the distended areas remain.

The effect discussed here can be reproduced with a piece of rubber tubing which has been twisted so as to have long spiral convolutions, and is then stretched. It will be found that the cross sections of the collapsed tube will open up and tend to assume a circular form.

The assistance of Messrs. T. L. W. Bailey, Jr., R. S. Orr, and J. J. Creely of the Southern Regional Research Laboratory in preparing the samples and making the tedious measurements involved in this study is gratefully acknowledged.

**Effect of Starching Variables on Fabric Stiffness Disclosed by Study of**

# Proper Starching Technique

**By ERNEST R. KASWELL***

*In view of the widespread application of starches for the sizing of yarns and fabrics, and, in particular, the present scarcity of starch, it is imperative that a maximum economy be attained in the use of this important raw material.*

*The following study was made for the specific purpose of improving the technique in laundry practice. However, it is believed that disclosure of the relationship between certain variables and fabric stiffness will be of assistance to textile men in general. It was found in this study that a linear relationship between the amount of starch and weight of material such as is frequently used in determining the proper amount of starch does not hold. By proper use of graphs the correct amount of starch for any given weight may be determined.*

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THE PRESENT MANPOWER AND MATERIAL SHORTAGES are problems for the manufacturer, laundry operator, and consumer alike. In a normal economy, methods assuring highest operating efficiency and increased customer satisfaction are imperative; in the existing war economy they are no less important to say the least.

With many service men and women wearing "summer whites," civilians and war workers turning more to washable clothing, the laundry faces ever increasing difficulties in coping with this situation with an under-staffed personnel and shortage of certain critical materials.

Proper starching technique is a prime requisite from an operating point of view. It encompasses attaining

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most economically the desired flexibility and maintaining that flexibility with a minimum of variation. Laundry starching procedure is obviously a batch process, while sizing of fabrics and yarn in the textile industry is a continuous one in most instances. The data presented in this paper is of necessity based upon the batch process. However, the principles involved may be applied in the textile field with certain modifications.

The factors in a commercial laundry upon which the degree and variability in stiffness of starched fabrics depend are many, and include the following:

*1—The Starch Batch*

A—Type
B—Concentration
C—Viscosity
D—pH

*2—Starching in the Laundry Wheel*

A—Concentration
B—Weight of material
C—Volume of solution
D—Temperature
E—Time

*3—Centrifuging*

A—Time
B—Velocity
C—Weight of material

Many of these variables are arbitrarily rendered constant under proper operating conditions. The type and concentration of starch, manner of cooking, time of cooking, and pH, all affect the viscosity and thus the ensuing stiffening power. If the same technique is repeatedly used in making up batches the uniformity of the batch can be fairly well controlled, although it must be admitted that starch viscosity is controlled with difficulty.

In the laundry wheel, the temperature, time, and solution volume can be fixed as can the extraction time and velocity. The factors remaining to be controlled are:

1—Starch concentration in the laundry wheel
2—Weight of material starched

The purpose of this investigation is to determine the effect of each of these factors on the ultimate stiffness of the fabric. The average laundry uses a linear relationship between the amount of starch and weight of material (e.g., 1 quart of a six-ounce starch per four pounds of

fabric; 2 quarts per eight pounds; 3 quarts per twelve pounds). If thought is given to this line of reasoning, it will be seen that, in order for such a linear relationship to hold, plots of (A)—Stiffness versus amount of starch at constant weight of material—and (B)—Stiffness versus weight of material at constant amount of starch—must be exactly the same in curvature, but opposite in slope. The experimental data given in this report do not show this to be the case. It appears that the stiffness is governed much more by the amount of starch used than by the weight of material starched.

**Experimental Procedure**

Thirty pounds of shirts were inserted in a thirty-pound capacity standard laundry washer. Strips $2\frac{1}{4}'' \times 8''$ of standard grade shirting material were cut, pinked to prevent ravelling, and placed in a small laundry net. Three strips were used for each experiment. The net was included with the thirty pounds of shirts and the entire load washed by a standard washing formula for forty minutes. The material was placed in an extractor and extracted for four minutes at eight hundred revolutions per minute. Using starch from a commercial laundry starch kettle, two quarts were added to the wheel and the total volume brought to fifty quarts by the addition of water, creating a three-and-a-half inch depth of solution. The temperature was kept as near one hundred degrees Fahrenheit as possible. The material was then re-inserted in the wheel and allowed to tumble in the starch. It should be noted here that the material was extracted before tumbling in the starch solution to prevent reduction in starch concentration by water trapped in the material after washing. At the end of seven minutes, the samples were removed, extracted for two minutes, and ironed on an automatic presser for twelve seconds. They were then allowed to come to equilibrium at 65% Relative Humidity and 70° F.

Taking three more $2\frac{1}{4}'' \times 8''$ samples and thirty pounds of material, the entire process was repeated. The starch was increased to five quarts, the total volume being kept at fifty quarts. The same process was repeated, using ten, fifteen, and twenty-five quarts of starch in

fifty quarts of total solution. Similar sets of experiments were conducted using twenty, fourteen, seven, and one pounds of material. A sample with no starch was run as a blank.

### Determination of Stiffness of Samples

Each $2\frac{1}{4}'' \times 8''$ sample was cut to give five $1\frac{1}{2}'' \times 2''$ samples to be used for the stiffness measurement. The samples were cut so that the $1\frac{1}{2}''$ length was in the same direction as the 8″ length in the original specimen. Extreme care was taken to make sure that the cut edges were smooth and straight.

Stiffness determinations were made with a Gurley Stiffness Meter. The clamp on the Gurley meter was so set that when the specimen was inserted in the jaw, the effective sample length was reduced to one inch. This was accomplished by inserting the sample one-quarter inch into the jaw, and having it lap over the vein for another quarter of an inch. The one-gram weight was used on the pendulum. It was found that by moving this weight to any of three positions—namely, one, two, or four inches from the center of the pendulum—all possible stiffnesses

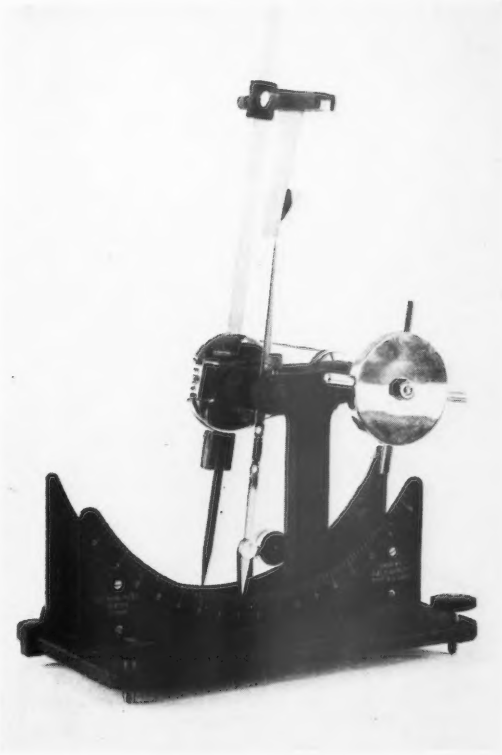


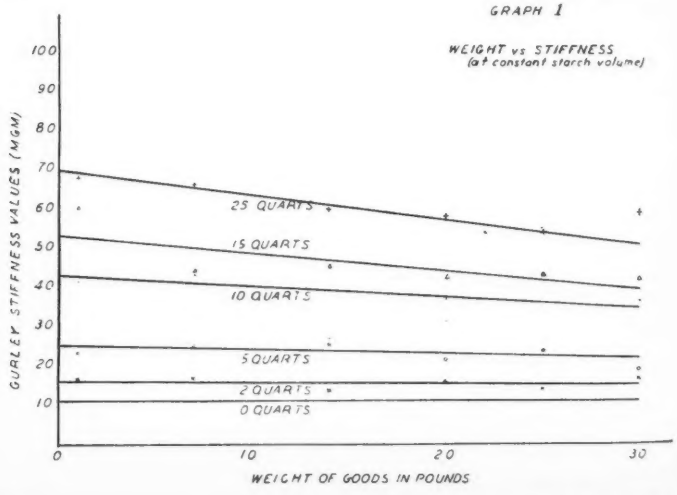
**Fig. 1. Gurley Stiffness Meter for measuring stiffness of fabrics.**

**TABLE I. Effect of Starch Concentration and Weight of Material on Fabric Stiffness**

| Quarts of Starch per 50 Quarts of Total Solution | Weight of Material Gurley Stiffness Values (mgms) | | | | | |
|---|---|---|---|---|---|---|
| | 1 lb. | 7 lbs. | 14 lbs. | 20 lbs. | 25 lbs. | 30 lbs. |
| 0 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 |
| 2 | 16.9 | 17.1 | 13.8 | 16.4 | 14.5 | 17.0 |
| 5 | 23.6 | 25.5 | 25.9 | 22.0 | 24.1 | 19.4 |
| 10 | 42.0 | 43.7 | 27.2 | 37.1 | 33.7 | 37.0 |
| 15 | 60.6 | 44.2 | 45.7 | 42.6 | 43.1 | 42.4 |
| 25 | 68.8 | 66.8 | 60.6 | 58.8 | 54.6 | 59.7 |

obtained could be easily measured without the pointer going off the scale. Each individual specimen tested was given three bends in each direction and the results averaged. As there were five specimens obtained from each eight inch strip and three strips for each experiment, stiffness values from fifteen individual pieces were averaged for each starching experiment. Because the center of gravity of the pendulum was shifted in order to encompass all stiffness readings without having the pointer go off the scale, it was necessary to convert all readings on the Gurley meter to milligrams by means of the calibrated chart furnished with the instrument.

Table I is a summary of the data taken. Examination of any horizontal column shows the effect of vary-



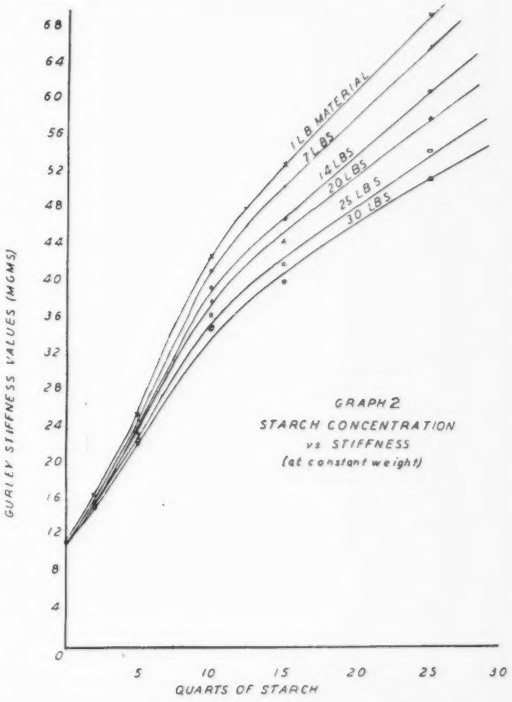
ing the weight of material starched while holding the amount of starch constant. Examination of any vertical column shows the effect of varying the amount of starch used while holding of material constant.

Graph 1 shows plots of stiffness vs. weight of material at constant starch volume. Graph 2 shows plots of stiffness vs. starch at constant weight of material.

**Discussion of Results**

From Table I and Graphs 1 and 2, it follows that at constant weight, the use of additional starch causes marked increase in stiffness. At constant starch volume, the addition of more material causes very little reduction in stiffness. Therefore, in routine starching, the normal variation in weight of material warrants but a negligible change in the amount of starch used. Variation of the amount of starch used in direct proportion to the weight of the material will result in great changes in stiffness.

By means of Graph 1, any desired stiffness can be obtained by selecting the proper amount of starch, the effect of weight of material variation being almost negligible. If, in regular practice, most of the lots starched are of about the same weight, the same volume of starch can always be used. However, where the variation in weight is great, by proper use of graphs made up substantially as those shown here, the proper amount of starch for any weight may be determined.



# ABSTRACTS

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## ANALYSIS: TESTING LABORATORY METHODS

### Apparatus for Testing Single Fibers

**Autographic load-elongation apparatus for fibers.** Arnold M. Sookne and Henry A. Rutherford. *J. Research*, Natl. Bur. Standards **31**, 25–31 (July, 1943).

An autographic load-elongation apparatus for testing single fibers is described. The apparatus is adapted to making a continuous load-elongation record at constant rate of elongation and to making a point by point record at constant rate of loading. It is also useful for obtaining relaxation curves for single fibers. Sensitive automatic operation is attained by means of photoelectric controls, and autographic recording in rectangular coordinates is provided. Examples are given of the performance of the apparatus.

### Graphical Method for Determination of Cotton Percentage

**Graphical method for obtaining "oven dry" cotton percentages in government lining fabrics.** H. C. Haller and Alfred Felgendreger. *Am. Dyestuff Reptr.* **32**, 301–2, 311–14 (July 5, 1943).

It is felt that a shortened procedure arrived at as a result of this study will be of value with run-of-the-mill testing. There should be no critical points that are difficult to govern. A graphical method is presented for ascertaining the "oven dry" basis cotton per cent using the "in air" (rapid) caustic boilout results correlated with relative humidity data. This graphical method is now being used for the routine control of lining cloth going through the plant. This means that early results are arrived at now which give a cotton content of acceptable accuracy. Should the 20 per cent maximum be exceeded with the calculated "oven dry" value, reference can be made to the old method as a means to check. It must be remembered that the graphs and the equation apply only to a 20 per cent cotton—80 per cent wool blend. If the composition were changed considerably, a new relationship would have to be established from data collected from the testing of that particular blend.

### Electron Microscope

**Some applications of the high resolving power of the electron microscope.** H. Green and E. F. Fullam. *Journal of Applied Physics* **14**, 332–340 (July, 1943).

High resolving power of the electron microscope is discussed as extending the field of microscopy to cover particles measuring 0.20–0.004$\mu$. Authors discuss four arguments against the electron microscope: (1) improper comparisons, (2) artifacts, (3) depth of focus, (4) resolving

power. The electron microscope is described as showing shapes and contours of particles that appear as circles or diffraction discs in the ordinary microscope. Photomicrographs are shown using visible light and ultraviolet light in the ordinary microscope and corresponding electron photomicrographs. Greater detail is obvious in electron micrographs.

### Elasticity of Rayon

**The dependence of elongation and elasticity of rayons on time and load. Walther Wegener.** *Zellwolle, Kunstseide, Seide* **46,** 298–303, 342–9 (1941); *Chem. Zentr.* **1942, I,** 557 (through *Chem. Abstr.* 1943, **37,** 2585[3]).

An app. suitable for making such detns. is described and illustrated, and tests with viscose, cuprammonium and acetate rayons are discussed in detail.

## CHEMICAL AND PHYSICAL RESEARCH

### Color Measurement and Specification

**Tristimulus specification of the "Munsell Book of Color" from spectrophotometric measurements.** K. L. Kelly, K. S. Gibson, and D. Nickerson. *J. Opt. Soc. Am.* **33,** 355–376 (July, 1943). *J. of Research,* Natl. Bur. Standards **31,** 55–76 (Aug., 1943).

From spectrophotometric curves for master standards of the 421 Munsell colors in the 1929 standard edition of the *Munsell Book of Color,* I.C.I. colorimetric computations are presented for four illuminants: I.C.I. Illuminants A and C, Illuminant "D" (Macbeth lamp-and-filter combination at 7500° K), and Illuminant "S" (limit blue sky). Full page I.C.I. (x, y)—diagrams for Illuminant C are included for each Munsell value level 2/ through to 8/, both Glenn-Killian and NBS measurements for each color being plotted for comparison. The work was done at the Bureau of Standards as a basis for the Inter-Society Color Council—National Bureau of Standards (ISCC–NBS) system of color names.

**Trichromatic specifications for intermediate and special colors of the Munsell system.** W. C. Granville, D. Nickerson, and C. E. Foss. *J. Opt. Soc. Am.* **33,** 376–385 (July, 1943).

The 1929 edition of the *Munsell Book of Color* contains papers representing 10 major hues from levels 2/ to 8/ at all even steps of chroma and 10 hues intermediate between these major hues on value levels 2/ to 8/ at even steps of chroma beginning with /4 chroma. These are the standard colors for which the National Bureau of Standards has made spectrophotometric measurements (see above). Because many people are not able to interpolate between hues as far apart as 1/20th of a hue circuit, "Munsell colors" now appear in an additional series of 20 hues. All /2 chromas omitted in the 1929 edition have also been added. These colors total 561 samples, in addition to the 421 samples of the standard series. Spectrophotometric curves were made in the laboratories of the Interchemical Corporation on all of these additional Munsell colors, also on several other Munsell series of colors made for special purposes; a series of 100 hues at 5/5, 50 hues at their maxima chromas, a 50-step value scale, a series of pinks, of browns, and others. Colorimetric data, computed for I.C.I. Illuminant C from these spectrophotometric curves, are included in the report in tabular form.

**Final report of the O.S.A. Subcommittee on the Spacing of the Munsell Colors.** S. M. Newhall, D. Nickerson, and D. B. Judd. *J.*

*Opt. Soc. Am.* **33**, 385–418 (July 1943).

Since 1937 a subcommittee has been steadily working to collect data and prepare the charts and tables upon which the recommendations in this final report are based. The report presents the characteristics of a modified and enlarged Munsell solid evolved from visual estimates of the *Munsell Book of Color* samples. The charts and tables in this report constitute the definition and standards for the revised system. They are recommended for general use in determining the Munsell re-notation of a given color sample when the I.C.I. specification is known, or for determining the approximate I.C.I. specification when the Munsell notation is given. Figures 1–9 present 40 hue loci corresponding to the full completement of samples in the latest edition of the *Book of Color,* together with the locus for every even chroma. I.C.I. Illuminant C has been taken as the neutral origin for both the hue and chroma loci. The aim has been to make both series of loci perceptually equi-spaced. Table I (9 pages) contains I.C.I. (Y, x, y)-equivalents of the recommended Munsell notation for 40 hues and 9 values at every second chroma step from zero to the theoretical pigment maximum. Table II contains I.C.I. luminous reflectance Y equivalents of the recommended Munsell value scale to value-step intervals of 0.01. Table III (3½ pages) contains renotations for the *Munsell Book of Color* samples in accordance with the recommended spacing and smoothing adjustments. The report first presents the recommendations of the subcommittee by means of tables and charts just noted. This is followed by a discussion of revision procedures, step by step. The report ends with the hope of the subcommittee "that these forms will prove useful until such time as the whole problem may be vigorously reinvestigated and a closer approximation toward the double ideal (psychological equispacing and precise applicability) realized."

**A psychological color solid.** D. Nickerson and S. M. Newhall. *J. Opt. Soc. Am.* **33**, 419–22 (July 1943).

In the preparation of the O.S.A. subcommittee report on smoothing the Munsell colors, data became available which permit approximate fulfillment of the following requirements for an ideal psychological color solid in cylindrical coordinates: the dimensional scales to be calibrated in perceptually uniform steps; the units of the several scales to be equated; the surface of the solid to represent all colors of maximum saturation; the volume to be representative of all colors which are perceptibly different; the conditions of stimulation and viewing to be prescribed; the scales to be standardized in terms of a generally recognized psychophysical system. Models of two solids have been constructed, one to portray the proportions when lightness and saturation have been equated for the just perceptible color difference, the other when they have been equated under more usual conditions when no special tax is imposed upon the discriminatory power of the normal observer. The two models provide a fair basis for an estimate of the number of surface colors distinguishable in daylight by a trained observer: about 7,500,000 colors distinguishable under the very best observational conditions; about 1,875,000 colors distinguishable under usual conditions of careful visual color matching.

## Dielectric Properties

**Dielectric properties of animal fibers.** Jacques Errera and Henri S. Sack. *Ind. Eng. Chem.* **35**, 712–16 (June, 1943).

At frequencies between 13 million

cycles (mc.) and 120 kilocycles (kc.) the dielectric constant of wool and mohair fibers and human hair is 4.2. The difference between this value and the square of the refractive index is appreciable. Measurements at different temperatures (+ 30° to — 70°C.) indicate that this difference is due to atomic or ionic polarization. A weak dispersion zone exists in the region below 120 kilocycles. The stretching of the fibers has no effect on the dielectric constant which is interpreted as being in agreement with Astbury's and Taylor's new patterns of x- and B-Keratin C. For comparison, the dielectric constants of silk and nylon fibers were measured. Silk behaves exactly like wool. Nylon has a lower dielectric constant, and the dispersion zone reaches into the high-frequency region (4 mc.).

## Effect of Humidity on Fiber Properties

**Effect of relative humidity on load-elongation properties of certain fibers.** H. Hindman and K. R. Fox. *Rayon Textile Monthly* **24,** 43–44 (May, 1943). *Ibid.* 43–45 (June, 1943).

A chainomatic tensile testing machine for yarns is described which provides data for plotting load-elongation diagrams. By use of a motor-compressor train and either drying towers or bubbling tubes, conditioned air is presented to the sample, thus enabling tests at either bone dry conditions or 100% relative humidity. Seven types of yarn: acetate, viscose, cuprammonium, Cordura, High Nareo, Fortisan, and nylon were investigated for load-elongation properties at 0%, 65% and 100% relative humidity at 70° F. Diagrams for each yarn at the several humidities are included. From a composite table of percent extensions at different humidities on a 70° F.–65% R.H. basis, it was reported that viscose rayon shows the greatest loss in strength as compared with the 65% R.H. test, whereas acetate, Cordura and High Nareo each show the next highest loss. Cuprammonium follows, while Fortisan and nylon, both stretch-spun filaments, show the least loss in strength due to humidity. In general, it seems to follow, that if the yarn is stretch-spun, less loss in strength due to humidity ensues. Results are analyzed from point of view of fiber structure showing that increase in molecular orientation due to stretch-spinning produces a more stable yarn with respect to humidity effects. Importance is attached to the correct selection of fiber depending upon the function it is to perform.

## Protein Fibers

**The development of synthetic protein fibers and their practical value, with special reference to "Thiozell." III.** Ehrhart Franz. *Melliand Textilber.* **22,** 436 (1941); *Chem. Zentr.* **1942, I,** 557; cf. *C. A.* **36,** 1184[5] (through *Chem. Abstr.* 1943, **37,** 2582[5]).

In addn. to HCHO there are many other compds. that produce combinations between the sep. protein mols. or block the hydrophil groups. In this way protein fibers are obtained that are superior to fibers made according to previously known methods.

## Water Adsorption by Glue

**Water adsorption by animal glue.** Charles M. Mason and Herbert E. Silcox. *Ind. Eng. Chem.* **35,** 726–29 (June, 1943).

The adsorption of water on thin films of five animal glues and one gelatin have been investigated, the glues covering the range of physical properties commonly employed. Both adsorption—and equilibrium—moisture content have been studied. The former obeys Fruendlich's law, and the latter is found to be greater than

represented by the moisture adsorbed on the surface. It is postulated that water is held by glue in two forms—by true adsorption on the glue surface and by some other mechanism in the voids of the glue itself.

## Viscosity and Molecular Weight

**Viscosity and molecular weight. I. The nitrate of wood carbohydrate.** S. Coppick. *Paper Trade Journal* **117**, 25–29 (Aug. 12, 1943).

This paper reviews the relationship between the viscosity of solutions of cellulose and its derivatives with the degree of polymerization and molecular weight. Viscosity functions are given for the nitrate of the carbohydrate material in wood, and these functions are compared with those for nitrated cotton. The reduced viscosity function of Staudinger is shown to be very inaccurate as an expression for molecular weight determinations. The intrinsic viscosity is a much more reliable function for degree of polymerization measurements on very high-molecular weight materials. The magnitude of the concentrations necessary for accurate viscometrical measurement of the molecular weight is indicated, and the use of formulas relating viscosity and concentration is advocated. It is shown that a maximum error of 5% is obtained in an intrinsic viscosity calculation based upon one viscosity measurement at a conveniently high concentration. This provides a rapid method for molecular weight measurements. The carbohydrate in wood is shown to have a much greater molecular magnitude than the literature assumes, and approaches that of raw cotton.

## Electrical Methods for Fiber Production

**The direct production of staple fibers from acetycellulose according to an electric spinning process.** Karl Werner. *Chem. Ztg.* **65**, 389–92 (1941); *Chem. Zentr.* **1942, I**, 1075–6 (through *Chem. Abstr.* 1943, **37**, 2928[7]).

According to Ger. pat. 689,870 the threads obtained from a soln. of acetylcellulose or chlorinated rubber are split into numerous threads by means of an elec. field and, following the evapn. of the solvent, the sep. fibers are conjoined into a fiber bundle. The fibers have good spinning properties, a wool-like feel and excellent heat-holding qualities. The strength of the wet fiber is similar to that of wool. The yarns can be processed without the slightest difficulty and are well suited to knitting.

# DYEING: BLEACHING: FINISHING

## Dyeing Carbonized Pieces

**Dyeing of carbonized pieces.** S. L. Peel. (From *J. Soc. Dyers & Colorists.*) *Textile Colorist*, **65**, 239–44 (June, 1943).

Methods are discussed and a list of dyes selected for specific uses is given. Faults due to over and under-carbonizing are discussed with suggestions for correction of uneven carbonizing. Various acid dyes were examined for their variation in affinity.

## Recent Developments in Continuous Indigo Dyeing

**Continuous dyeing of indigo.** Geo. O. Linberg. *Am. Dyestuff Reptr.* **32**, 318–20 (July 19, 1943).

Previously reported was the development of a continuous process for indigo dyeing of piece goods. Further details of dyeing and control methods are given. The process has now been extended to continuous dyeing of raw stock with indigo. A continuous wool washer was used and a full shade obtained. This process leaves the wool in a much better condition for subsequent carding, spinning and weaving than is usually obtained with various methods now in force. The

loom efficiency approaches that of white wool. Experience indicates that wool dyed in the interval of minutes rather than hours suffers less degradation of the fiber and results in fabrics of greater strength, better hand, and superior quality.

## Vat Dyeing of Blends

**Vat dyeing spun rayon and blends of cotton, wool and acetate.** Allison Fitzgerald. *Textile Bulletin* 64, 14–16, 34 (Aug. 1, 1943).

Methods of preparing greige goods of spun viscose rayon and cotton are briefly described and for desizing and boil-off. Operations are listed for spun rayon-acetate fabrics.

## Carbonizing

**A study of the neutralizing of carbonized 32 os. olive-drab overcoating.** Kermit S. La Fleur. *Am. Dyestuff Reptr.* 32, 275–79 (June 21, 1943).

Pieces dyed with Alizerol Brown RH and Eriochrome Flavine A redden considerably in sulfuric acid carbonizing. This reddening increases as the per cent acid increases. Maintenance of uniform acidity in the carbonizing bath is necessary. Adequate neutralization is imperative if uniformity in shade is to be obtained. Swatches were neutralized with given percentages of soda ash and runs made for number of given periods of time and tested for acid content. Data is given and curves drawn illustrating the results. It was found that 10 minute initial rinse, then 1 hour in neutralizing bath using 125% of the amount of soda ash required for theoretical neutralization, followed by 10 minute final rinse, gives best all around conditions for commercial work.

## Dyeing Chlorinated Wool

**The causes of the uneven dyeing of chlorinated wool.** L. Bonnet. *Teintex* 5, 260–1 (1940); *Chem. Zentr.* 1941, I, 1884 (through *Chem. Abstr.* 1943, 37, 2937[9]).

The causes of streaked dyeing of chlorinated wool are, first, nonuniform chlorination and, second, the high rate at which chlorinated wool takes up the dye (cf. Trotman, *C. A.* 27, 4085). Good results can be obtained with the dyeing app. of A. Albertini, in which chlorination and dyeing are done at reduced pressure.

## Microscopical Observations of Wool Dyeing

**Microscopical observations of wool dyeing. Part III—Physical factors affecting color value.** G. L. Royer, H. E. Millson, and E. I. Stearns. *Am. Dyestuff Reptr.* 32, 285–90 (June 21, 1943).

The amount of dye exhausted from a dye bath does not represent the final color value that is obtained on dyed goods. The color value is influenced by the distribution and location of the dye in the fabric, thread, and individual fiber. It was previously shown that the distribution of dye from fiber to fiber is an important factor relative to the shade and color strength that is obtained and also relative to certain fastness properties. Poor fiber levelness was shown to give low color value and when the same amount of dye was properly distributed the color value increased. In this paper, an attempt has been made to show by blending that fiber unlevelness gives poor color strength and a different shade. This confirms earlier publications in which this conclusion was made from microscopical examinations. The effect of fiber diameter upon color strength has been shown using 64's and 36's wools. These show that for the same amount of dye, the greatest color value is obtained on the coarser wool, i.e., more dye must be used in dyeing fine wool in order to match the same shade on coarse wool. A brief discussion of the optical phenomena en-

tering into the color value obtained on wool has been given.

### Finishing of Rayons

**The finishing of dull rayons.** Horst Wachtler. *Spinner. u. Weber* **59**, No. 44, 54 (1941); *Chem. Zentr.* **1942, I,** 1076 (through *Chem. Abstr.* 1943, **37**, 2584[9]).

Strong alkalies must be absent in preliminary washing operations. Finishing products made from aliphatic alcohols were found to be most suitable in actual practice. Goods which are badly soiled are best treated with an aliphatic alc. contg. highly active fat solvents. An aliphatic alc. product should be used also in the dye liquor. An excessively long dyeing operation may give luster to the goods. Various precautionary measures are suggested. Uneven heating and strong currents of air may cause streaks. The light should be kept away by covering the textile with cloths. After rinsing, the goods should be dried and then well cooled. Dull rayons of the cuprammonium type should be softened by a special process. Best results are obtained when the dyer supplies the goods to the finisher in the dry state only, as the dry dull rayons are not affected by the weather. The finisher should moisten only as much material as he can handle in a single day. Wet goods should be covered and protected against air currents. Machine drying is the only good drying procedure for woven and Jersey goods.

### Federal Specifications for Textile Finishes

**What the Government buys. A digest of finishing specifications.** Anon. *Textile World* **93**, 70–71 (July, 1943).

A table is shown which lists those fabrics which are required in special finishes, the treatment specified, and the use for which the fabric is intended. Also given are the specification numbers and the procurement agency or agencies purchasing each fabric.

## FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

### Effects of Fiber Properties upon Processing

**Fiber from the spinner's viewpoint.** Carl D. Brandt. *Rayon Textile Monthly* **24**, 63–65 (July, 1943).

Fiber qualities of importance in manufacturing and how they effect processing are discussed. The article deals principally with the cotton fiber. Effect of staple length on yarn strength and effect of twist are illustrated by charts. It was found that the drop in yarn strength becomes relatively more rapid as the cotton becomes shorter. Using 1.2 turns per inch as a normal value it is noted that the slight difference of a reduction of two-tenths of an inch reduces the breaking strength resistance of roving to roughly one-sixth of the normal value, while over-twisting three-tenths of a turn increases the resistance to twice the normal. An average 20s yarn spun during these tests actually produced a break of 1.38 pounds against a theoretical break for normal cotton of 6 pounds per single strand.

### Camouflage

**Role of textiles in camouflage. Data which will help mill men to meet requirements of Army and Marine Corps.** Anon. *Textile World*, **93**, 68–69 (July, 1943).

Textiles required for purposes of camouflage are of two general classes: (1) impregnated cotton osnaburg and burlap, and (2) camouflage nets. Government specification numbers are given and a description of requirements and methods of treating fabrics to afford protective concealment of troops and equipment.

A listing of the principal direct sources for data on camouflage concludes the article.

### Military Fabrics

**Manual of military fabrics, VI—8.2 oz. Cotton Twill, Type IV.** Anon. *Textile World* **93**, 72–73 (July 1943).

This article is sixth in a series which commenced with the February issue of *Textile World*. Abstracts of the previous articles will be found in TEXTILE RESEARCH for June, page 39, and July, page 38. An abstract of Government Specifications is given, also manufacturing and finishing details are described for 8.2 oz. cotton twill, Type IV. A mill organization chart is presented for the manufacture of this fabric.

## MISCELLANEOUS

### Training New Employees

**Training new employees quickly.** Anon. *Textile World* **93**, 59–62 (July, 1943).

How a comprehensive plan for training new employees quickly and for upgrading experienced workers to more responsible positions was developed by WMC in cooperation with one of the larger southern textile mills is described. The essential features of the program include: (1) use of Manning tables and replacement schedules; (2) training job instructions; (3) working out job progression charts; (4) drawing up operation sheets for each job; (5) training new employees; and (6) training maintenance men and loomfixers. A training supervisor was appointed to coordinate all the training. He was given a general training advisory council of management representatives and instructors to provide him with first-hand information. The first step was a survey to determine those jobs in the plant where the need for replacement was greatest and to select the jobs which are best for beginning practice and skills. A well trained staff of teachers was developed. A training schedule based on the information revealed from job descriptions was prepared. In preparing operation sheets the operations listed were divided into teaching units, each of which would include not more than 8 or 10 new ideas in order to prevent confusion of the learner. Pre-employment training of high-school students was conducted to form a reserve of new workers that could take jobs in the mill with little additional training. Apprenticeship training was conducted for a limited number of jobs. Relatively few cotton mill jobs require all-around skill that classifies them as apprenticeable as, for example, are the jobs of general maintenance, loomfixing, second hand, and supervisor. The plan was tailor-made for one particular mill and would need to be modified for other mills to suit local conditions and requirements.

### Employee Training

**Streamlined Training.** Anon. *Textile World*, **93**, 63 (July, 1943).

How the WMC's Job Instructor Training Program has helped one mill relieve a serious shortage of skilled help is related by a practical mill man.

### Effects of Laundering Practices

**The effect of laundering and laundry-bleaching processes on cotton, linen and viscose fabrics.** E. Honegger and A. Schnyder. *J. Text. Inst.* **34**, T 29–40 (June 1943).

In this study fabrics were subjected to washing tests which show that the soap-soda laundering process with or without bleach is more effective in cleansing than a process using syn-

thetic detergents. Fabrics were subjected to chemical as well as mechanical tests. The degree of polymerization of the cellulose, the ash content and the quantity of calcium and magnesium compounds deposited on the fiber during washing were determined. The destructive action of bleach is shown, 50 launderings with bleach reduced the size of the macromolecules much more than 100 launderings without bleach. Bleaching with sodium perborate in hard water is less injurious than when soft water is used. A definite loss of strength due to rinsing was also observed. Linen is more susceptible to both mechanical and chemical damage than cotton. The resistance to wear of fabrics washed in soap, soda and hard water fell rapidly after 10 launderings but soft water processes effected an improved wear resistance. Chalk and lime soap are especially injurious. The effect of hard water laundering is shown by microphotographs.

## Plastic Laminates

**Basic physical properties of laminates.** Philip M. Field. *Modern Plastics* **20**, 91–102 (August, 1943).

(The rapid development of plastic laminates reinforced by textile and other fibrous materials is of immediate and direct concern to the textile industry. Editor.)

In sharp contrast to the amount of information available on the physical properties of metals, the quantity of data on the properties of plastics is meager. This paper contributes data on the more important physical properties of some laminates, including the high-strength laminates reinforced with paper, glass, asbestos, and cotton. Data are presented on the tensile, edgewise compressive, flexual, bearing, shear, and impact strengths.

## Synthetic Detergents

**Cooperative studies on a laboratory method for evaluating synthetic detergents.** J. B. Crowe. *Am. Dyestuff Reptr.* **32**, 237–41 (May 24, 1943).

Soiled wool and cotton fabrics were used for evaluating synthetic detergents by members of A.S.T.M., Section E on Sulfonated Detergents, Sub-Committee II on Specifications. These test fabrics were washed in launderometers and graded on photometers. This paper gives a résumé of the conclusions and opinions of the cooperating members, together with brief descriptions of the methods used. Details of a typical procedure used for soiling, washing and grading cotton and wool are appended.

## Sulfonated Oil Products

**Sulfonated oil products. Notes on some properties and uses in textile processing, "Technicus."** *Textile Colorist* **65**, 283–87, 330 (July 1943).

A review is given of a number of textile applications. Various aspects of the subject are illustrated by practical experiences of the author and others in the use of Turkey-red and of sulfonated oils as dispersing agents for dyestuffs.

## Water Softening

**Alkalies containing water glass for use in industrial laundering waters.** A. Foulon. *Monatschr. Textil-Ind.* **56**, 225–6 (1941); *Chem. Zentr.* **1942, I**, 285 (through *Chem. Abstr.* 1943, **37**, 2587[5]).

Alkalies, contg. water glass, e.g., Henko (a definite mixt. of $Na_2CO_3$ and water glass), soften industrial waters more rapidly and more readily and produce softer waters than do alkalies which do not contain water glass. They remove temporary and permanent hardness and facilitate the whole washing operation by carrying away any Fe and Mn salts.